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STRUCTURED SELF-REGULATION INTERVENTION AND GLYCEMIC CONTROL IN INDONESIAN ADULTS WITH TYPE 2 DIABETES

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Abstract

This study evaluated the effectiveness of a culturally adapted self-regulation intervention in improving glycaemic control among Indonesian adults with type 2 diabetes mellitus. A quasi-experimental pretest–posttest study was conducted among 148 outpatients in Surabaya, Indonesia, allocated to either an intervention group or a standard care control group. The six-week group-based programme incorporated goal setting, self-monitoring, self-evaluation, problem solving, and adaptive coping. Baseline clinical characteristics, including body mass index (BMI) and glucose-lowering therapy, were comparable between groups (all $p > 0.05$). Glycaemic control was assessed using glycated haemoglobin (HbA1c) at baseline and after six weeks. Participants receiving the intervention demonstrated a significant reduction in HbA1c (-0.98%, 95% CI: 0.73–1.23; $p < 0.001$), whereas no significant change was observed in the control group ($p = 0.203$). Post-intervention HbA1c levels were significantly lower in the intervention group than in the control group ($p = 0.002$). High adherence and complete follow-up supported the feasibility of the programme.

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These findings suggest that structured, culturally adapted self-regulation interventions can effectively complement pharmacological treatment and strengthen diabetes self-management among adults with type 2 diabetes.

Key words: diabetes mellitus, type 2, self care, behaviour therapy, hemoglobin A, glycosylated, Indonesia

Introduction. Type 2 diabetes mellitus (T2DM) is a major global health challenge, with increasing prevalence driven by population ageing, urbanisation, and lifestyle changes [1]. Indonesia is among the countries experiencing a substantial diabetes burden, largely associated with dietary transitions and sedentary behaviour [2]. Glycaemic control, commonly assessed using glycated haemoglobin (HbA1c), is essential for preventing diabetes-related complications and improving long-term outcomes [3]. Although pharmacological treatment remains the cornerstone of diabetes management, optimal glycaemic control also depends on sustained self-management behaviours.

Self-regulation theory provides a framework for promoting health behaviour change through goal setting, self-monitoring, self-evaluation, and behavioural adaptation [4]. Interventions based on self-regulation principles have been associated with improved diabetes self-management and glycaemic outcomes in various populations [5]. However, diabetes education programmes in Southeast Asia often focus on information delivery rather than structured behavioural strategies, resulting in inconsistent clinical benefits [6]. In Indonesia, many diabetes interventions remain insufficiently theory-based and rarely incorporate systematic self-regulation techniques such as goal setting and self-monitoring [5,7]. This limitation is particularly relevant because chronic disease management is strongly influenced by sociocultural factors, including family involvement and collective decision-making [8]. Despite increasing recognition of behavioural approaches in diabetes care, evidence regarding culturally adapted self-regulation interventions for Indonesian adults with T2DM remains limited.

Therefore, this study evaluated the effectiveness of a six-week culturally adapted self-regulation intervention on glycaemic control among Indonesian adults with T2DM. We hypothesised that participants receiving the intervention would achieve greater reductions in HbA1c than those receiving standard outpatient care.

Materials and methods. A quasi-experimental pretest–posttest study with parallel intervention and control groups was conducted at the outpatient diabetes clinic of Rumah Sakit Islam Surabaya, Indonesia, between April and July 2025. Of 235 patients screened, 148 eligible adults with type 2 diabetes mellitus were enrolled and allocated to an intervention group ($n = 74$) or a standard care control group ($n = 74$). Sample size was estimated using G*Power 3.1 assuming a medium effect size (0.50), $\alpha = 0.05$, and statistical power $\geq 80\%$. Eligible participants were aged 45–85 years, had a confirmed diagnosis of type 2 diabetes mellitus

for at least six months, were receiving oral glucose-lowering therapy, and provided written informed consent. Exclusion criteria included cognitive impairment, severe comorbidities limiting participation, hospitalisation during recruitment, or inability to complete the intervention. To minimise baseline imbalance, groups were matched according to age, sex, diabetes duration, and baseline HbA1c.

The intervention comprised a six-week face-to-face group-based self-regulation programme delivered by trained nurse educators. Weekly 60–90 min sessions addressed goal setting, self-monitoring, self-evaluation, problem solving, behavioural adaptation, healthy eating, physical activity, medication adherence, and blood glucose monitoring (Table 1). The programme was culturally adapted using Bahasa Indonesia educational materials, locally relevant dietary examples, and family-oriented self-management strategies. Participants attending at least five of the six sessions were considered adherent. The control group received routine outpatient diabetes care, including physician consultations, medication management, clinical monitoring, and standard diabetes education.

T a b l e 1

Structure of the six-week self-regulation intervention

Week	**Topic**	**Self-regulation component**	**Main activities**
1	Understanding diabetes and goal setting	Goal setting	Establishing individual self-management goals
2	Healthy eating	Self-monitoring	Recording dietary intake and identifying eating patterns
3	Physical activity	Action planning	Developing personalised activity plans
4	Medication adherence and glucose monitoring	Self-evaluation	Reviewing adherence behaviours and monitoring progress
5	Managing barriers to self-care	Problem solving	Identifying obstacles and developing coping strategies
6	Maintaining behavioural change	Behavioural adaptation	Relapse prevention and long-term self-management planning

The primary outcome was glycated haemoglobin (HbA1c), measured at baseline and after six weeks using hospital laboratory records or high-performance liquid chromatography when recent results were unavailable. Baseline clinical variables included body mass index (BMI), diabetes duration, and glucose-lowering therapy, categorised as metformin monotherapy, sulphonylurea monotherapy, or combination oral therapy. Changes in glucose-lowering therapy during follow-up were not systematically recorded and therefore were not analysed. Continuous variables are presented as mean ± SD and categorical variables as frequencies and percentages. Baseline comparisons were performed using independent-samples t-

tests or χ^2 tests, as appropriate. Within-group changes in HbA1c were analysed using paired-samples t-tests, and between-group differences were assessed using independent-samples t-tests. Statistical significance was defined as $p < 0.05$.

The study was approved by the Health Research Ethics Committee of Universitas Nahdlatul Ulama Surabaya (No. 0168/EC/KEPK/UNUSA/2025). Written informed consent was obtained from all participants, and the study was conducted in accordance with the Declaration of Helsinki.

Results. Of the 235 patients screened, 148 met the eligibility criteria and were enrolled in the study. Participants were allocated equally to the intervention group ($n = 74$) and the control group ($n = 74$). All participants completed the six-week study period, resulting in a follow-up rate of 100% (Fig. 1).

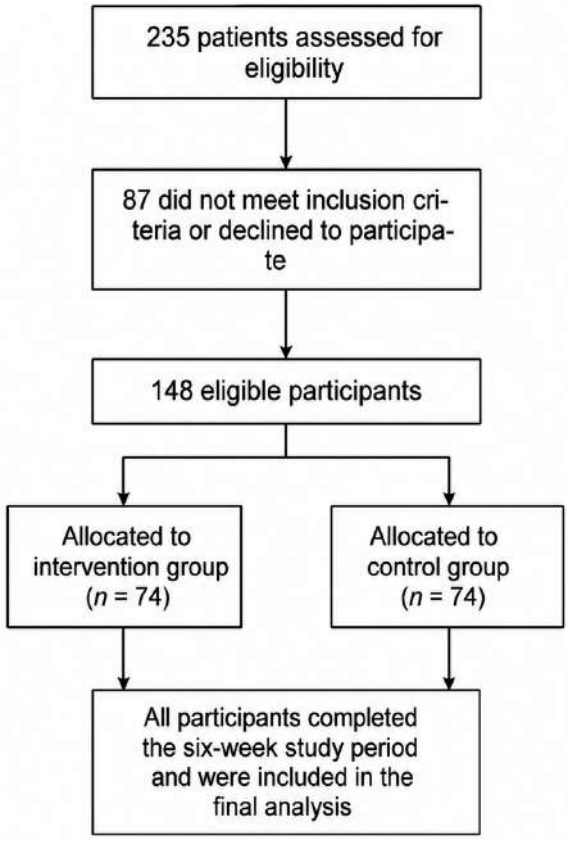


Fig. 1. CONSORT flow diagram

Baseline characteristics. Baseline demographic and clinical characteristics are presented in Table 2. No significant differences were observed between the intervention and control groups with respect to age, sex, duration of diabetes, educational level, employment status, baseline HbA1c, body mass index (BMI), or glucose-lowering therapy (all $p > 0.05$). Specifically, BMI ($p = 0.542$)

Table 2

Baseline demographic and clinical characteristics of participants ($n = 148$)

Variable	Intervention group ($n = 74$)	Control group ($n = 74$)	p-value
Age (years), mean ± SD	61.36 ± 10.21	62.20 ± 10.33	0.614
Sex, n (%)			0.861
Female	43 (58.1)	44 (59.5)	
Male	31 (41.9)	30 (40.5)	
Duration of diabetes (years), mean ± SD	1.96 ± 0.45	2.14 ± 0.60	0.052
Body mass index (kg/m^2), mean ± SD	27.5 ± 4.1	27.1 ± 3.9	0.542
Baseline HbA1c (%), mean ± SD	7.26 ± 1.55	6.85 ± 1.62	0.126
Glucose-lowering therapy, n (%)			0.782
Metformin monotherapy	35 (47.3)	38 (51.4)	
Sulphonylurea monotherapy	12 (16.2)	10 (13.5)	
Combination oral therapy	27 (36.5)	26 (35.1)	
Education level, n (%)			0.924
No schooling	5 (6.8)	6 (8.1)	
Elementary school	12 (16.2)	10 (13.5)	
Junior high school	17 (23.0)	14 (18.9)	
Senior high school	25 (33.8)	28 (37.8)	
College	15 (20.2)	16 (21.6)	
Employment status, n (%)			0.614
Not employed	42 (56.8)	45 (60.8)	
Employed	32 (43.2)	29 (39.2)	

and glucose-lowering therapy distribution ($p = 0.782$) were comparable between groups, indicating adequate baseline equivalence prior to intervention delivery.

Changes in glycaemic control. After six weeks, participants in the intervention group demonstrated a significant improvement in glycaemic control. Mean HbA1c decreased from $7.26 \pm 1.55\%$ at baseline to $6.28 \pm 1.47\%$ at follow-up, corresponding to a mean reduction of 0.98% (95% CI: 0.73–1.23; $p < 0.001$). In contrast, the control group showed no significant change in HbA1c over the same period ($6.85 \pm 1.62\%$ vs. $6.74 \pm 1.65\%$; $p = 0.203$). Comparison of post-intervention outcomes revealed significantly lower HbA1c levels in the intervention group than in the control group ($6.28 \pm 1.47\%$ vs. $6.74 \pm 1.65\%$; $p = 0.002$), indicating greater glycaemic improvement following participation in the structured self-regulation programme (Fig. 2).

Intervention adherence and study completion. Intervention adherence and retention were high throughout the study period. All enrolled participants completed the post-intervention assessment, and no losses to follow-up occurred in either group. These findings support the feasibility and acceptability of the

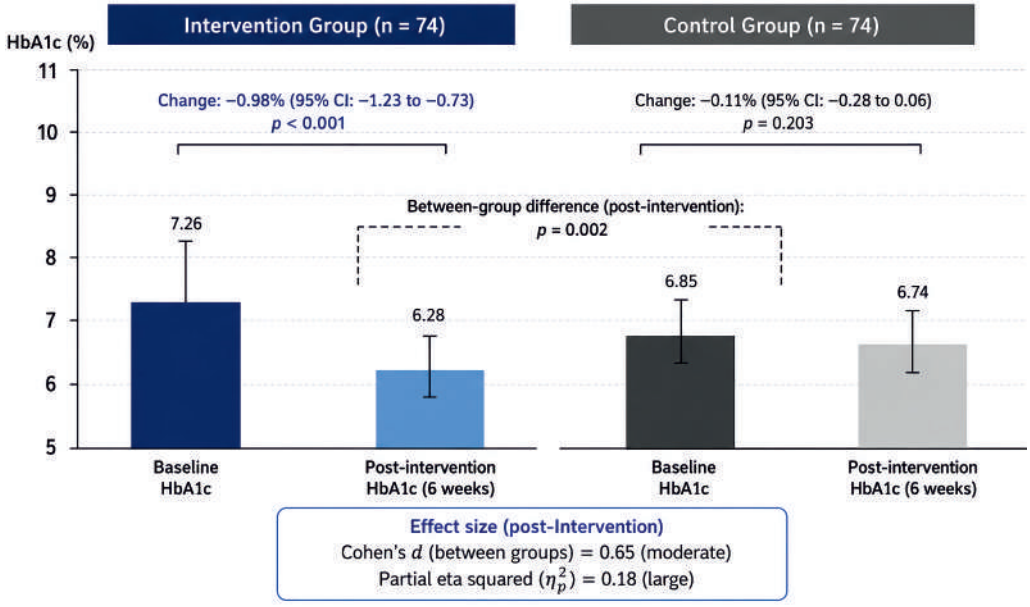


Fig. 2. Changes in HbA1c levels before and after the intervention

culturally adapted self-regulation programme within routine outpatient diabetes care.

Discussion. The present study demonstrated that a structured and culturally adapted self-regulation intervention significantly improved glycaemic control among Indonesian adults with type 2 diabetes mellitus. Participants who received the six-week intervention achieved a mean HbA1c reduction of 0.98%, whereas no statistically significant improvement was observed among those receiving standard care. This magnitude of reduction is clinically meaningful because reductions approaching 1% in HbA1c have been consistently associated with lower risks of diabetes-related complications and improved long-term clinical outcomes [3]. The findings therefore suggest that behavioural interventions targeting self-regulatory processes can provide important benefits beyond routine pharmacological management.

The observed improvement is consistent with self-regulation theory, which emphasises goal setting, self-monitoring, self-evaluation, and behavioural adaptation to sustain health behaviours [9]. These processes strengthen self-efficacy and promote adherence to diabetes self-management [10], which may explain the observed reduction in HbA1c.

The findings are also consistent with previous studies reporting beneficial effects of self-regulation and self-management interventions on diabetes outcomes. Evidence suggests that behavioural interventions incorporating self-monitoring, problem solving, and goal-directed action can improve medication adherence, di-

etary behaviours, physical activity, and glycaemic control among individuals with type 2 diabetes [5, 11]. The reduction in HbA1c observed in the present study is comparable to improvements reported in structured diabetes self-management programmes, supporting the view that behavioural interventions can serve as effective adjuncts to pharmacological treatment. Unlike many educational interventions that focus primarily on knowledge acquisition, the current programme emphasized active behavioural change processes, which may explain the observed clinical benefits.

Previous studies indicate that diabetes education in Indonesia is often information-based and lacks structured behavioural strategies [12, 13]. By integrating evidence-based self-regulation techniques into routine outpatient care, the present intervention addresses this gap and demonstrates the feasibility of theory-driven diabetes education in a middle-income setting.

The culturally adapted design of the intervention may have enhanced its effectiveness. Educational materials were delivered in Bahasa Indonesia, incorporated familiar dietary examples, and emphasised family-oriented self-management, reflecting the sociocultural context of Indonesian communities [8]. Such adaptations have been associated with greater participant engagement and behavioural adherence [14], which may explain the high attendance and complete follow-up observed in the present study.

Comparable baseline body mass index and glucose-lowering therapy between groups reduce the likelihood that baseline clinical differences accounted for the observed improvement in HbA1c. Nevertheless, glycaemic control is influenced by multiple interacting factors, including medication adherence, lifestyle behaviours, disease progression, and pharmacological treatment [15]. Furthermore, changes in glucose-lowering therapy during follow-up were not systematically recorded; therefore, their potential contribution to HbA1c improvement cannot be excluded. Future studies should investigate behavioural mediators, including self-efficacy and treatment adherence, while accounting for medication changes over time.

From a health system perspective, structured self-regulation programmes delivered by trained nurse educators may provide a scalable and cost-effective strategy to strengthen diabetes self-management, particularly in resource-constrained healthcare settings where the burden of type 2 diabetes continues to increase.

This study has several limitations. The quasi-experimental design limits causal inference, and the single-centre setting may reduce generalisability. In addition, medication changes during the six-week follow-up were not systematically assessed, introducing the possibility of residual confounding. Finally, the short follow-up period precluded evaluation of the long-term sustainability of behavioural and glycaemic improvements. Future randomised controlled trials with longer follow-up should evaluate reinforcement strategies, including booster sessions, digital health interventions, and family-based support, to sustain behavioural change and optimise long-term glycaemic control [16].

Conclusions. This study demonstrates that a structured and culturally adapted self-regulation intervention can significantly improve glycaemic control among Indonesian adults with type 2 diabetes mellitus. Participants who completed the six-week programme achieved a clinically meaningful reduction in HbA1c compared with those receiving standard outpatient care, accompanied by high adherence and complete study retention. These findings support the integration of theory-driven, multi-session self-regulation interventions as complementary strategies to pharmacological treatment in diabetes management. Nevertheless, the findings should be interpreted in light of the quasi-experimental design, the inability to assess changes in glucose-lowering therapy during follow-up, and the relatively short follow-up period. Further randomised controlled trials with longer follow-up are needed to confirm the effectiveness and sustainability of the intervention and to better understand the behavioural mechanisms underlying improved glycaemic outcomes.

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